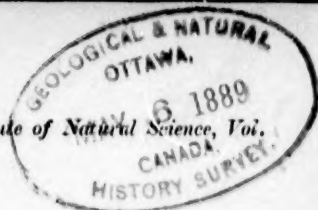


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ART. III.—GLACIAL BOULDERS OF OUR FISHERIES AND INVERTEBRATES, ATTACHED AND DETACHED.—BY THE
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Read January 14th, 1889.

The presentation to our Provincial Museum by Henry Lawson, Esq., of three interesting boulders from our fishing banks, specially directed attention to the subject of our paper.

Each of these is adorned by a prominent and singular organism, which attracted the attention of the fisherman who found them. To the striking and puzzling character of these we are indebted for the preservation of the boulders and their attachés.

The boulders are of Lower Cambrian quartzites. They were brought up from a depth of 65 fathoms. Our Museum has a number of other boulders from the same banks. Some of these we have had for many years. Other interesting ones have been received from Mr. Lawson and others, since we began our investigations. During my glacial researches I have directed the Devil's Island fishermen to bring boulders from the shore of that Island and the fishing banks, with or without attachés. I am thereby enabled to ascertain that our glacial transportation had extended a considerable distance into the Atlantic. I have already noted Thrum Cap and its shoal as the *ultima thule* of this glacial transportation. We are not disposed, on the evidence of our boulders, to extend it to 60 or 80 fathoms, or 26 miles beyond Thrum Cap or Devil's Island. This *may* have been effected by bergs or floes from our glaciers, ice sheets, or other causes. It is possible that icebergs from Arctic regions, which are often seen on our coast, borne along by the Arctic current, may have contributed their quota to the boulders of our fishing banks. This, however, is only a peradventure.

Our Boulders are—

1. Archæan Granite, of Halifax.

2, 3, 4, 5, 6. Lower Cambrian Quartzites.

7. Calcareo-Quartzite, corresponding with rocks of Eastern Passage. (*Vide* Geology of Halifax, &c., Trans. I. N. S.)

8. 9. &c., Argillites.

10. Diorite, like that of Sunday Point, Yarmouth. (*Vide* Geology of Digby and Yarmouth, Trans. I. N. S.)

11 to 22. Lower Carboniferous Limestones, like those of Hants County. Boulders of these abound in the glacial moraine deposits at Laurencetown Head and entrance to Eastern Passage. (*Vide* Papers on Surface Geology, Trans. I. N. S.)

Our 11 boulders are all perforated marvellously by *Saxicava artica* (*rugosa*), a characteristic mollusc of the Champlain Period, which still abounds in our harbour and on the fishing banks.

In a paper read before the Institute—"Additional Notes on Glacial Action at Bedford Basin, Halifax Harbour, &c.,"—Trans. Vol. VI., pp. 251-260,—is a list of Mollusca from Jones' catalogue of 1887. In the list of 42, we have 12 Arctic and 30 Boreal. We will find many of these mollusca attached to our boulders. The other associated invertebrata have also a Boreal facies, *e. g.*, the "Spongidae." Hence the illustrated memoirs of the Norwegian North Atlantic Expedition in our Institute Library has been largely available in our recent investigations.

Classification of our Invertebrata.

- I. Protozoa—*Foramenifera* and *Radiolaria*, Metazoa or Parazoa Sponges.
- II. Cœlenterata—*Hydroida*.
- III. Annuloida—*Starfishes*, &c., *Ophiura*.
- IV. Annulosa—*Crustaceans*.
- V. Mollusca—*Saxicava* and *Buccinum*, &c.

In Lawson's 1st Boulder (A) the most prominent attaché is an Ootheca. Its first appearance suggested an ear of indian corn. A closer examination shows the egg capsules of a mollusc, but different from the familiar clusters of *Purpura lapillus*. We find the two associated in one of the museum collections from Sable Island.

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In a plate of the Buccinidae of the Norwegian North Atlantic Expedition, we find the figures of two similar of reduced size. We assign ours to *Buccinum undatum*, our allied boreal mollusc. In one of my walks on the shore of Point Pleasant, last summer, I observed an unusually large number of the clusters of empty egg capsules of *Purpura lapillus*, cast ashore during a storm. I searched in vain, among them for our Ootheca. I opened the specimen of boulder (B). It was empty, all the fry had escaped. The next in prominence on our boulder (A) is a dark brown sponge, *Myxilla lawsoni*. We leave this and other sponges for another paper. Other attachés are polyzoa. Entangled in these we have a beautiful shell of the tiny *Margarita undulata*, another boreal mollusc.

Mr. Willis reported this shell to Gould as found on our banks.

A lower valve of *Anomia* was also found on the Sponge.

Five small *Gammari* lay in the thick pendant plume of a sertularia.

A *Caprella*, species? Was attached to the sponge.

A small *Balanus* adheres to the stone.

Serpula are abundant on the stone, and a *campanularia* on the sponge.

One species of *serpula* has a crypt-spire. A *spirorbis* is also attached to the *Margarita*. *Sertularida* of more than one species are prominent. One has a number of branches forming the plume in which the *gammari* were esconced. The *Campanularia* with attached *spirorbes* trails over the sponge forming a net in which the *Margarita* was entangled. *Bryozoa* with a small encrusting sponge. *Suberites incrustans*? complete the very interesting group of attachés of this Boulder (A). We number the boulders as they are described with large capitals for reference in this and the following Papers of our series. Lawson boulder (B) in addition to its Ootheca, has several *bryozoa* and two sessile *foramenifera*.

Lawson boulder (C) has another Ootheca and an interesting sponge—*Myxilla*. Also, a multitude of sessile *foramenifera*.

As already stated, these three boulders are of Lower Cambrian Quartzites. (D. E. F.) are also quartzite boulders. These are

adorned with branching sponges, *Reniera*. (D.) has only a sponge. (E.) has bryozoa, a small *Balanus* and *Spirobes*. (F.) has two species of *Spirobes*, a small *Anomia* and small *Balani*. (G.) boulder is an argillite with a side of quartz; this has a very singular sponge—a *Suberites* and a small variety of the *Suberites incrustans*? the small sponge on boulder (A), also, serpulæ, spirorbes, bryozoa (coralline) and foramenifera. (H.) has another interesting sponge—*Suberites villosum*. Other four argillites have as follows:

No. 1 has a serpula, spirorbes, *Terebratulina septentrionalis* with its sponge, and another sponge, *Reniera*.

No. 2 has a sponge *Suberites* and *Terebratulina*, with its sponge a *Myxilla*.

No. 3 has *Terebratulina septentrionalis* and its sponge, and a remarkable sponge—*Stelletta hansenii*.

No. 4 has *Terebratulina* with its sponge. *Serpula* and a remarkable sponge—*Stelletta étoile-pistolet*.

We have given provisional names to the two *Stellar* sponges.

(I.) a diorite boulder from the Halibut Fishery, called by the fisherman Little Banquereau, has a branching coral, *Primnoa reseda*? and the remains of a sponge—*Suberites*. Other corals of the same kind and locality, but detached are also to be found in our museum collections.

(K.) is a large and heavy boulder. It is of calcareo-quartzite. It is singularly and deeply excavated—*water-worn*. This character of the original rock at Cow Bay and Eastern Passage, attracted my attention when I was surveying the region, and led to the recognition of their *calcareous* character, in the proportion 30 per cent., Vide Paper, Geology of Halifax and Colchester Counties, Tran. Vol. VI., Page 62. One of the cavities of the boulder is coated with a white sponge—*Myxilla eximia*, a small cavity contains a small sponge, a *Reniera*. Other attachés are *foramenifera*, *hydrozoa*, *serpulæ*, *spirorbes*, *ophiura*, *bryozoa*, *coralline*.

(L.) boulder is of granite—it is ponderous. Two fishermen brought it to the Museum many years ago. It was regarded as curious, on account of a large sponge which was firmly attached

to it. This is a remarkable and unique specimen of *Geodea*. Between its base and the granite, *Saxicava* had inserted themselves, and were there embedded.

Numerous patches of *bryozoa* still remain on the boulder. The sponge had to be detached for its safe keeping and proper examination.

Having thus briefly described the boulders of Lower Cambrian rocks and associated Archæan Granites with their varied and interesting attached and detached invertebrates, we now proceed with like brevity to notice the remaining group of our introductory catalogue and attachés.

(M.) another ponderous boulder is of deceptive appearance. It was long assumed to be a quartzite. Its perforation was regarded as remarkable. This also was brought from our fishing banks. When I directed particular attention to it, I found that it was a limestone. The application of the hammer showed that the perforations were deeper and larger than they appeared, and were occupied by *Saxicava* and *Ophiura*. The limestone is also recognized as of Lower Carboniferous age.

(N.) is another limestone boulder. It is regularly stratified. *Saxicava* have penetrated the strata horizontally; the upper strata present the aspect of a coral. This is caused by a coating of nullipores and bryozoa, which appears chalky from exposure to the rain and sun. It thus assumes quite a cretaceous aspect. The hammer shows the true character of the limestone. An *Ophiura* and a small *Echinus* occupied cavities.

(O.) is of the same character with chalky patches.

(P.) is another limestone boulder. This has been perforated by *Saxicava* entering on the edges of the laminae. The perforations are empty.

(Q.) Is a thoroughly perforated boulder of Lower Carboniferous Limestone. Its cavities contain one or two *saxicava* and *serpulæ*. A flat side is thickly studded with *Spirorbes* of, at least, two species. Numerous *Serpulini* lie among these.

(R.) Is another limestone boulder, much perforated by *Saxicava*. A small one lies in a cavity.

(S.) Is another. It is limestone veined with Calcite. It is

also perforated by *Saxicava*. Two of these occupy cavities. There are no other attachés in this and the preceding.

(T.) Is also a limestone boulder of considerable size. It is thoroughly perforated by *Saxicava*. The top and circumference are covered with Nullipores. Two algæ, one of which is *Corallina officinalis*, a lime former, occupy a large part of the nullipore covered top. Several ophiuræ occupy holes. The hammer shows the boulder to be Lower Carboniferous limestone.

Boulder (U.) Has attachés, *Terebratulina septentrionalis* in abundance—young and old. The latter are coated with the usual sponge, a *Myxilla*, sessile foramenifera, hydroids, a large *Serpula* tube, an *ophiura*, specimens of *Chiton ruber*. It is of Lower Carboniferous limestone.

(V.) Another L. C. limestone boulder. This is well perforated by *Saxicava*. The greater part of the cavities is occupied by Ophiurans, old and young. This is by far the greatest number found in any boulder. I have not yet attempted to specialize them. All our Ophiurans, or brittle stars, have the usual number of 5 rays. An exception will be noted in a future paper. This has 6 rays. I simply refer to it in this connection as a notice. Other attachés of our boulder are *Serpulini*, *Spirorbes*, *Bryozoa*, *Corallines*, *Foramenifera*, *Incertæ Sedis*.

(W.) the last boulder to which I would refer. It is the last addition to the Museum collection. The fisherman from whom it was purchased informed me that it came from the banks, and from a depth of 65 fathoms. It is of Lower Carboniferous Limestone, and is thoroughly bored with *Saxicava*. Some of these occupy under cavities. Ophiurans have taken possession of others. The upper side of the boulder is covered with nullipores.

Two interesting sponges are seated on the nullipores. Of these, the smaller is of dark brown colour, it is a *Myxilla*. The larger is different in appearance from all the other sponges in our collection—it is a *Reniera*.

I received from Mr. Wilson, Fish Merchant, a splendid specimen of *Boltenia rubra* from our fishing banks. It was detached from the stone to which it had been attached. Its stalk is 12 inches

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in length. This is completely covered with attachés; campanularia coats it. From this projects a pendant sponge—a *Reniera*—a Bryozoa, coralline, of beautiful form and of the same character as others frequently noticed on boulders, is also prominent.

We have also two large, detached, bushy sponges with thick and short stalks. These are *Renieras*.

I would only refer to another sponge from our fishing banks. It was brought up from a depth of 80 fathoms, at a distance of 40 miles south of Sambro. It is shaped like the "Cap of Liberty." It is a Hexactinallid—a sponge of the highest order. It was highly appreciated at the I. F. E., and regarded as unique. It seems to have been unattached.

This completes our series of sponges. Their aspect also is decidedly Boreal, as well as that of the other invertebrata of our Fishing Banks.

I have yet to note the presence of *Radiolaria* and *marine diatoms*, which may be regarded as a sort of attachés. They are found in almost every one of the sponges attached to the several boulders. The smallness of pieces of sponges examined, and the number found in these pieces, indicate abundance in the sponges, and consequently teeming waters. From the Bulletins of the Blake Expedition we were led to infer the absence of Radiolarians in our Northern Atlantic waters. The Radiolarians are *Protozoa*, and the Diatoms *Protophyta*. When we report the examinations of our sponges these Protos will be duly noticed.

In this Bulletin reference is made, as elsewhere, to Mr. Verrill's finding Boulders on the Fishing Banks, St. George's, etc., which led him to the striking conclusion, "That a Tertiary Formation probably might be regarded as underlying our Coastal Fishing Banks." We, on the contrary, might now be led to consider that our own banks are underlaid by a Carboniferous Formation, and that the more readily, as Lower Carboniferous Limestones, do exist at Chester, to the west of Halifax. Our knowledge of the Geology of Nova Scotia and glacial investigations lead us to the alternative set forth in our introduction, and to regard the

Geological Formation underlying our Fishing Banks as rather allied to the First division of its Glacial Boulders—as Lower Cambrian.

(Appendix).

We would add a few notes to the Paper read which will bring under notice other invertebrates not attached wholly to boulders. We are indebted to others for those already noticed. The succeeding have been collected in our walks around the shores of Point Pleasant. It is many years since we first noticed sponges with other attachés on the "so-called roots," of the great quantities of *Laminaria* and other large algæ cast ashore by the sea after storms which had torn them from the rocks to which they had been attached. Heretofore, we regarded these as of no peculiar interest. Choice specimens of the sponges were, however then collected, put in proper jars with alcohol, and placed in the lowest position in our Alcoholic Collection. These sponges are associated with, and sometimes almost enveloping, large specimens of *Modiolus modiola*, *Mytilus edulis*. The calcareous alga *Corallina officinalis* very often accompanies these ^{also} *Saxicava* old and young. The hydrozoa, campanularia and sertularida, bryozoa and spirorbes also abound. Gammarii swarm. Clusters of the egg capsules of *Purpura lapillus* and the univalve itself are found often enough in connection, and the *Littorina littorea* of all sizes. Since we became interested in the sponges, by the discovery of their siliceous character and the beauty of their skeletal and somal spicules and incorporated diatoms and radiolarians, we have often explored the piles of kelp after storms and made a large collection of the objects described, especially the sponges.

In this kelp I found, many years ago, when searching for marine objects of interest, a densely reticulated alga with the spawn of small fish newly developed. Putting it into a small bottle having alcohol, I observed a number of small, oval sponges. One of these I have just examined, and found it to be a *Myxilla*. I have given it the specific name *pisciniae*.

I would, in conclusion, notice the valve of a *modiola*. This has attached to it, a bunch of a beautiful alga, and an interesting

sponge—*Reniera*. This was for some time, singular by the incorporation of the diatom, *Grammatophora serpentina*, in abundance. From this I gave it the specific name *anguillellida*.

Mr. McLeod, of Demerara, gave me a piece of *Pecten tenuis-trigatus* from Chester, N. S., with an incrusting sponge, a *Reniera*. My collection in the Canadian Department of I. F. E., Lond, 1883, contained a short, branching sponge, which was found attached to a valve, of *Ostrea virginiana* from Prince Edward Island. This is *Suberites edouardii*.

NOTE.—Two other boulders have been added to our collection. X is of Lower Carboniferous Limestone. Its weight is 31 lbs. On it are two *Suberites*, one *Myxilla*, and two *Stellatias étoile-pistolet*.

Boulder Y has a *Suberites*.